Universidad Michoacana San Nicolas Hidalgo

A study of some physicochemical properties, sensory evaluation and shelf-life of freeze-dried yoghurt made with skimmed milk, inulin and *Saccharomyces boulardii*

Hector E. Martinez Flores

Food Technology 2015,
London

Yoghurt

- Yoghurt is the food produced as a result of fermenting milk with one or more bacterial cultures that contain the lactic acid-producing bacteria, *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Food and Drug Administration, 2014).



Probiotics

- The word probiotic means “for life”.

- The internationally-endorsed definition of probiotic is:

“live microorganism that, when administered in adequate amounts ($1x10^7$ FUC/mL), confers health benefits on the host”.



FAO/WHO (2001).

Yoghurt as a probiotic carrier food

- Different types of products such as yoghurt have been proposed as carriers for probiotic microorganisms in foods, by which consumers could ingest large amounts of probiotic cells for their therapeutic effect.

Saccharomyces boulardii

- Natural yeast isolated from the bark of the *Litchi* tree in Indochina.

- S*. boulardii* is:

✔ protective in the intestine against *Clostridium difficile* and cholera toxins

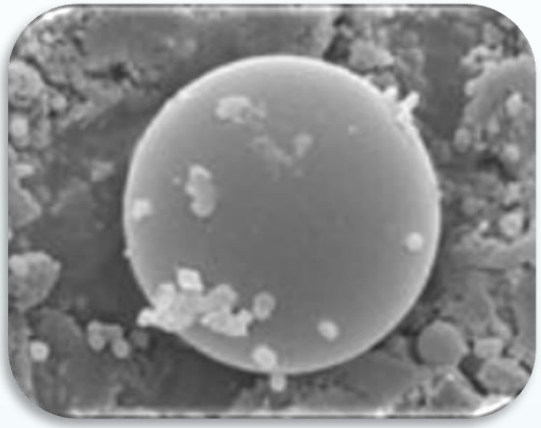
✔ effective in preventing antibiotic-induced diahrroea

✔ decreases inflammation and

✔ inhibits bacteria toxins.

MICROENCAPSULATION

Method used to improve the survival of microorganisms



Microencapsulation is a technique in which liquid droplets are covered by a porous polimeric film (alginate, chitosan, starch, etc…) that contains an active substance, such as *S. boulardii*).

Objective

- To develop two formulae of freeze-dried yoghurt obtained with skimmed-milk, containing vegetable oil, inulin and *Saccharomyces boulardii*
- The first formula had the yeast added as free cells.
- The second formula had the yeast added in microencapsulated form.

MATERIAL & METHODS

RAW MATERIAL



"Siluette"® milk with 0.2% fat.



Lactic culture: *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus salvarius* subsp. *thermophilus* Danisco®.



Saccharomyces boulardii.



Inulin from *Agave tequilana* subsp. Weber Blue var., which contains 97% inulin and 3% fructose.



Palm-oil supplied by AarhusKarlshamn company.

METHODOLOGY



Biomass production of *S. boulardii*

↓

Microencapsulation of *S. boulardii*

↓

Elaboration of yoghurt based on inulin, palm-oil and *S. boulardii* either microencapsulated or as free cells

↓

Freeze-dried yoghurt

↓

Physicochemical, chemical and sensory evaluation

↓

Study of accelerated shelf-life test of products

YOGHURT

F1 = Yoghurt with inulin + palm-oil added (Control)

F2 = Yoghurt with inulin + palm-oil + 0.5% of *S. boulardii* added.

F3 = Yoghurt with inulin + palm-oil + 0.5% of *S. boulardii* microencapsulated added .



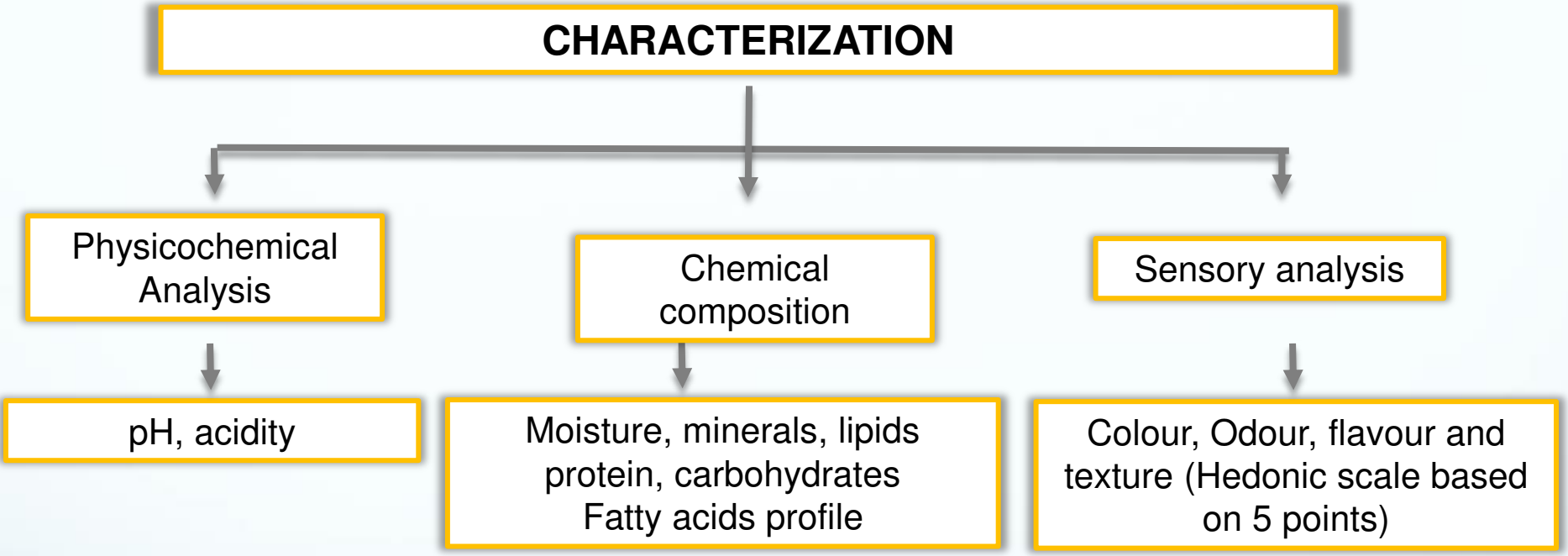
Yoghurt



Fresh yoghurt

Freeze-dried yoghurt

CHARACTERIZATION OF FREEZE-DRIED PRODUCTS



ACCELERATED SHELF-LIFE



Packed freeze-dried yoghurt

25 g of each sample were placed in metalic bags and stored at 35°C in an incubator

↓

Samples were monitored at 0, 3, 6, 9, 13, 17, 21 days

↓

Microbiological enumeration of S. boulardii

RESULTS

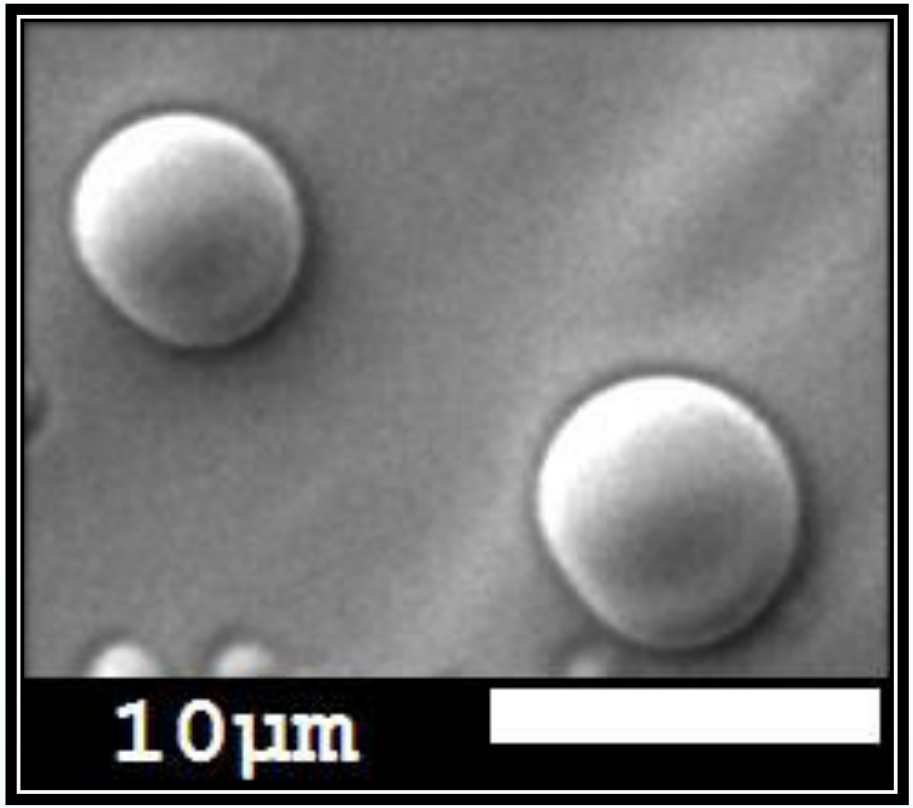


Figure 1. Microcapsules containing *S. boulardii* (SEM, x 1,000), with an average size of 9.2 µm.

Table 1. Viability of *S. boulardii* in the freeze-dried products.

	Fresh yoghurt Log CFU/g	**Freeze-dried yoghurt Log CFU/g**
F1	0.00[a]	0.00[a]
F2	9.05[a]	8.94[a]
F3	8.93[a]	8.81[a]

N = 3 ± standard error. The same letter in the same line is not significantly different ($p<0.05$).

The difference in F2 (fresh yogurt) and F3 (freeze-dried yoghurt) was minimal and was not statistically different ($p <0.05$).

Table 2. pH and acidity of yoghurt.

		F1	F2	F3
pH	Rehydrated yoghurt	4.49[a]	4.43[a]	4.51[a]
Acidity (%)	Rehydrated yoghurt	0.81[a]	0.83[a]	0.79[a]

N = 3. ± standard error. The same letter in the same line is not significantly different ($p<0.05$).

- pH range of yoghurt from 4.43 to 4.51, contributes to a better hydration of proteins together with the consistency of yoghurt.
- Yoghurt must have a minimum acidity of 0.5%. In all our products we obtained appropriate values of acidity

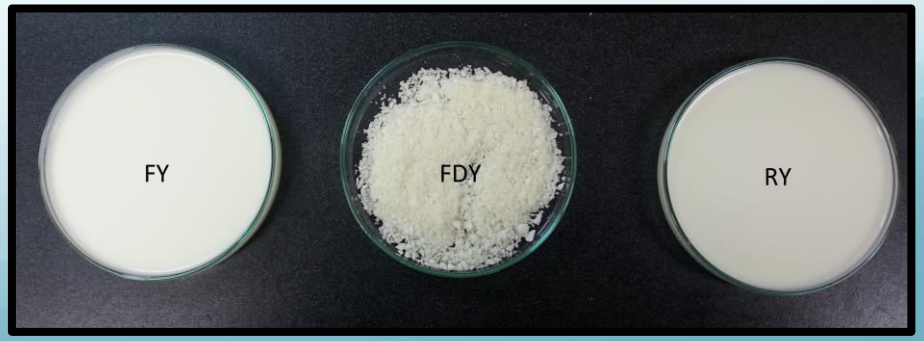


Table 3. Chemical composition of yohgurt.

(%)	F1	F2	F3
Moisture	5.40	5.3	5.63
Protein	13.08	13.53	13.59
Fat	11.01	11.53	**15.43**
Minerals	3.16	3.27	3.02
Carbohydrates	67.35	66.37	62.33

An increase was observed in the lipid content (in F3 as compared to F1 and F2), due to the incorporation of lipids during the microencapsulation process (ionic emulsion water/fat process).

Table 4. Fatty acids profile in yoghurt samples.

Fatty acids	Fat in cow milk * (%)	Palm-oil (%)	F1 (%)	F2 (%)	F3 (%)
SATURATED					
Butyric	3.6				
Caproic	2.3				
Caprylic	1.2				
Capric	2.2				
Lauric	3.6	0.20	0.35	0.25	
Myristic	10.7		0.61	0.83	0.48
Pentadecanoíc	1.7				
Palmitic	25.9	15.75	20.13	21.09	12.90
Estearic	10.1	4.42	8.72	9.69	5.96
Elaiidic		0.36	0.31		0.43
Araquidonic	0.7	0.62		0.60	
Others	0.8				
Total	**62.80**	**21.35**	**30.12**	**32.46**	**19.77**
MONO-UNSATURATED					
Myristoleic	1.0				
Palmitoleic	1.9		0.18		0.24
Oleic	26.2	48.88	43.41	42.64	53.76
Others	1.6				
Total	**30.70**	**48.88**	**43.59**	**42.64**	**54.00**
POLY- UNSATURATED					
Linoleic	2.0	21.34	18.80	18.00	17.53
Alfa-linolenic		3.59	3.23	3.18	5.09
Gamma-linolenic		1.15	1.50	1.03	1.61
Linolenic	0.7				
Gadoleic		1.06	0.90	0.88	1.01
Others	0.2				
Total	**2.90**	**26.08**	**24.43**	**23.09**	**25.24**

Table 5. Sensory analysis of the different yoghurts.

5 = Is the highest favorable attribute evaluated.

	F1	F2	F3
Colour	3.46^{a}	4.2^{a}	3.93^{a}
Odour	3.46^{a}	3.2^{a}	3.46^{a}
Flavour	3.53^{a}	3.6^{a}	2.46^{b}
Texture	4.20^{a}	4.0^{a}	3.07^{b}
General appearence	**3.71^{a}**	**3.75^{a}**	**3.55^{a}**

N = 15 panelists ± standard error. The same letter in the same line is not significantly different ($p<0.05$).

In the attribute of texture, evaluators detected the microcapsules in the F3 product, which contributed to give a lower response.

ACCELERATED SHELF-LIFE

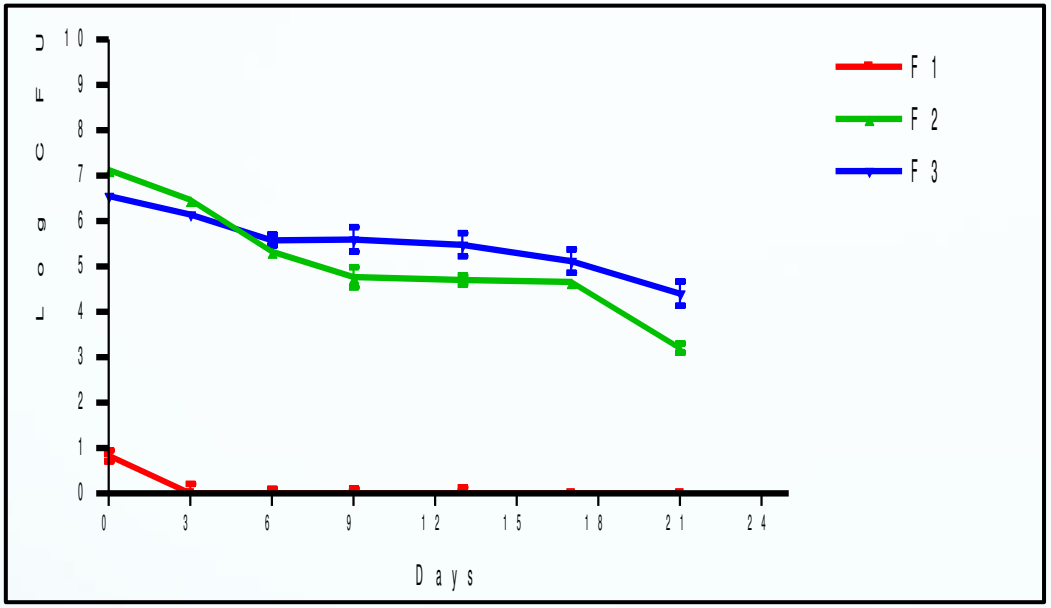


Figure 2. Viability of *S. Boulardii* according to time lapse (n=3).

Considering that a temperature of 25°C (Q_{10} 1 unit), a temperature of 35°C had a Q_{10} of 2 units.

At 35 °C the value of $Q_{10} = 2$ 1 day = 4 days = $(2)^2$

- In F2, a count of 7.12-Log CUF/g was found and after 17 days (68 days) 4.66 -Log CUF/g.

- In F3, a count of 6.55 -Log CUF/g was found and at day 21 (84 days) a value of 4.40 -Log CUF/g.

The viability loss of *S. Boulardii* was:

- In F2 of 3.92 log units.

- In F3 of 2.15 log units.

Conclusion

- We were able to formulate a yoghurt by replacing milk fat with palm oil, inulin and *Saccharomyces boulardii* without affecting either physicochemical characteristics or viability of the probiotic agent.

Thanks